## REMARKS

The applicant appreciates the Examiner's thorough examination of the application and requests reexamination and reconsideration of the application in view of the following remarks.

The Examiner rejects claims 1-12 under 35 USC §112, second paragraph as allegedly being indefinite. The Examiner indicates it is unclear how the plurality of actuators can possibly shape the mirror surface when the actuators are not even physically connected to the mirror surface.

The applicant respectfully disagrees with the Examiner that claim 1 is indefinite under 35 USC §112, second paragraph. The applicant's claimed integrated actuator meniscus mirror as recited in claim 1 includes: 1) an optical substrate including a mirror surface on one side and a support structure on the other, and 2) a plurality of actuators embedded in the support structure spaced from and generally parallel to the mirror surface for applying bending moments to the mirror surface for controllably altering the shape of the mirror surface. As shown in Figs. 3 and 4 of the applicant's specification reproduced below, the claimed plurality of actuators (30) are embedded in recesses (22) of ribs (18) of the support structure.

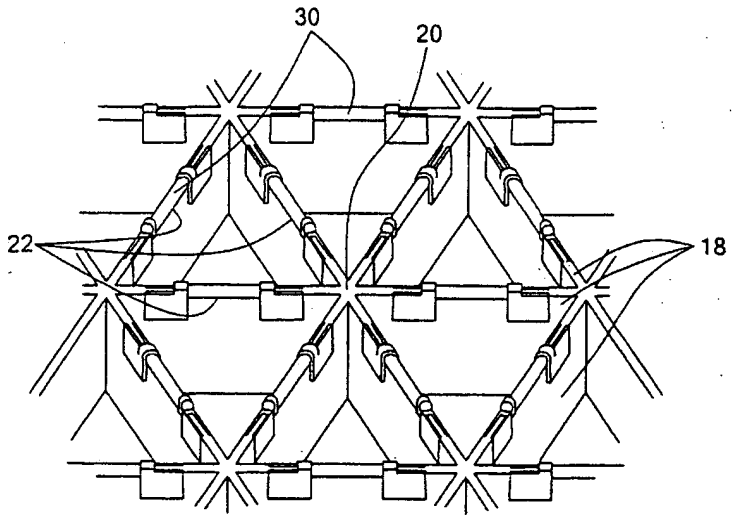


*FIG. 3*

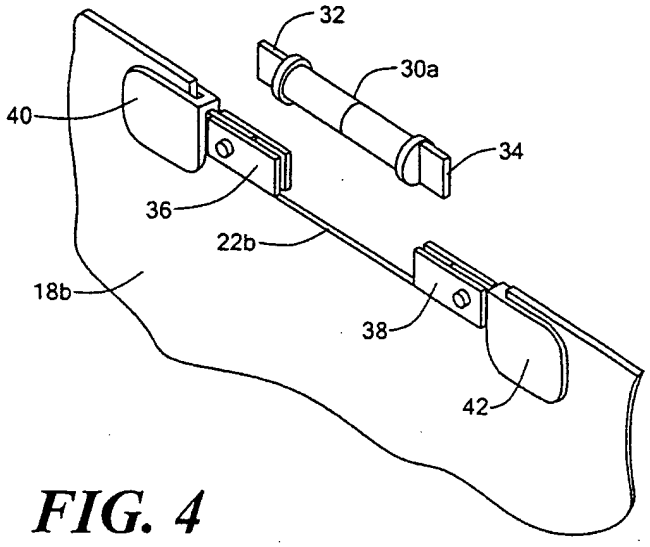


*FIG. 4*

When extended or contracted, the actuators apply bending moments that alter the shape of the mirror surface, both locally for correctability and globally to affect the radius of curvature alterations. Because the actuators act directly on the support structure which they are embedded they require no reaction mass. Moreover, even though the actuators may be displacement devices, they can perform a very effective radius of curvature or

excursion shape alteration because their effect is cumulative. *See* page 7, lines 11-18 of the applicant's specification. *See also* Fig. 2 of the applicant's specification reproduced below which shows the unique lattice honeycomb structure on the backside of the mirror (10) with recesses (22) for receiving the actuators (30, 30a) shown in Figs. 3 and 4.

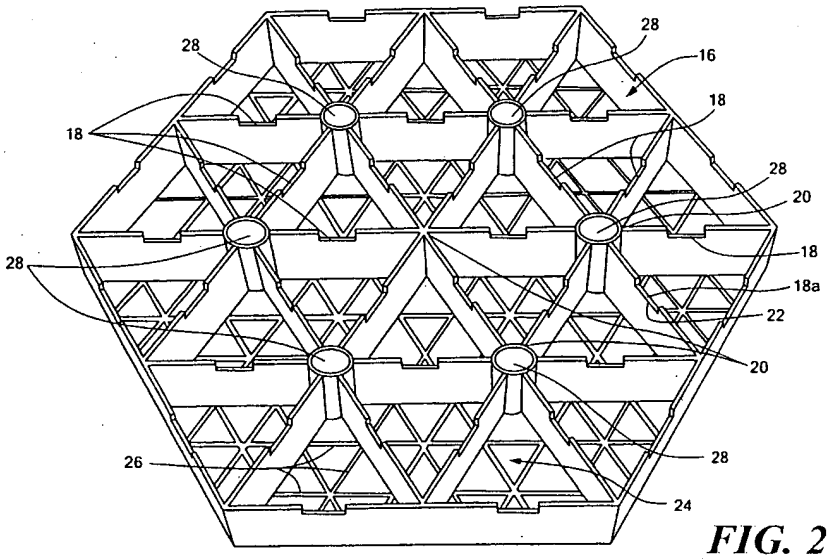


*FIG. 2*

Accordingly, claim 1 is definite and in accordance with 35 USC §112, second paragraph. Because claims 2-12 depend from claim 1, these claims are also definite and in accordance with 35 USC §112, second paragraph.

The Examiner rejects claims 1, 2, 11, and 12 under 35 USC §102(b) as being anticipated by Sawicki.

The improved, lightweight integrated actuator meniscus mirror of the applicant's invention includes an optical substrate including a mirror surface on one side and a support structure on the other, and a plurality of actuators embedded in the support structure spaced from and generally parallel to the mirror surface for applying bending moments to the mirror surface for controllably altering the shape of the mirror surface. The applicant's

integrated actuator meniscus mirror requires no reaction mass yet has a good natural frequency, aerial density, excursion, and correctability characteristics. The support structure of the optical substrate provides for strengthening and further supporting the mirror surface. *See* the applicant's specification, page 7, lines 2-6. The claimed actuators act directly on the support structure in which they are embedded to controllably alter the shape of the mirror surface. *See* the applicant's specification, page 7, lines 14-18.

In contrast, Sawicki does not teach, suggest, or disclose an integrated actuator meniscus mirror that includes an optical substrate including a mirror surface on one side and a support structure on the other that provides for strengthening and support of the mirror. Sawicki also does not teach, suggest or disclose a plurality of actuators embedded in the support structure spaced from and generally parallel to the mirror surface for applying bending moments to the mirror surface for controllably altering the shape of the mirror surface. Instead, Sawicki teaches and discloses a laser correcting mirror that utilizes spaced legs that are rigidly fixed to, and extend from, the mirror body with the actuators (adjustment mechanisms) disposed between the spaced legs:

> The legs 14, 16, 18, 20, 22, 24, 26 and 28 are rigidly affixed to the mirror body 12 such that forces applied to the legs 14, 16, 18, 20, 22, 24, 26 and 28 will be transferred to the mirror body 12 and will tend to distort the mirror body 12 along with the light reflective surface 13 thereof. A first adjustment mechanism 42 is associated with the first leg pair 34 for applying forces thereto. In like manner, a second adjustment mechanism 44 is associated with the second leg pair 36, a third adjustment mechanism 46 is associated with the third leg pair 38 and a fourth adjustment mechanism 48 is associated with the fourth leg pair 40.

Col. 4, lines 17–28, emphasis added.

Fig. 1 of Sawicki also clearly shows legs 14-28 extending from mirror body 12 and the actuators (adjustment mechanisms 42-48) disposed between the legs. The actuators of

Sawicki apply forces to the various legs to achieve bending moments to the mirror surface for controllably altering the shape of the mirror surface. Clearly, the rigidly affixed legs that extend from the mirror body of Sawicki are not designed for strengthening and supporting the mirror surface. Instead, the legs are used to simply dispose the actuators therebetween. Moreover, the actuators as taught and disclosed by Sawicki are not embedded in the support structure.

Therefore, for the reasons stated above, Sawicki does not teach, suggest, or disclose each and every element of the applicant's invention, namely, an optical substrate having a mirror surface on one side and a support structure on the other side, and a plurality of actuators embedded in the support structure spaced from and generally parallel to the mirror surface for applying bending moments to the mirror surface for controllably altering the shape of the mirror surface as recited in the applicant's claim 1.

Accordingly, applicant's independent claim 1 is patentable and allowable under 35 USC §102(b) over Sawicki. Because claims 2, 11, and 12 depend from an allowable base claim, these claims are patentable and allowable under 35 USC §102(b).

The Examiner rejects claims 1-3, 5, 7, 9 and 11 under 35 USC §102(b) as being anticipated by Döngi *et al.*

Döngi *et al.* teaches and discloses actuators disposed perpendicular to the mirror surface and that apply motion in a direction orthogonal to the mirror surface. *See* Fig. 1 of Döngi which clearly shows the actuators disposed perpendicular to the mirror surface and applying motion in a direction orthogonal to the mirror surface.

Döngi *et al.* also does not teach, suggest or disclose embedding the actuators in a support structure as recited in applicant's claim 1. Instead, Döngi *et al.* teaches and

discloses a mirror that includes back and front thin actuator layers (1) and (5) with several individually controllable actuator elements. The front thin actuator layer (5) is sandwiched between pressure distribution layer (6) and the front sandwich cover layer (4). Pressure distribution layer (6) is glued to front actuator layer (5). Similarly, the back thin actuator layer (1) is attached to the back sandwich cover layer (2).

Therefore, Döngi *et al.* does not teach, suggest or disclose each and every element of the applicant's invention as recited in independent claim 1, namely, a plurality of actuators embedded in the support structure spaced from and generally parallel to the mirror surface for applying bending moments to the mirror surface for controllably altering the shape of the mirror surface.

Accordingly, applicant's independent claim 1 is allowable and patentable under 35 USC §102(b) over Döngi *et al.* Because claims 2, 3, 5, 7, 9, and 11 depend from an allowable base claim, these claims are allowable and patentable under 35 USC §102(b) over Döngi *et al.*

The Examiner rejects claims 1, 2, 5-9, 11, and 12 under 35 USC §102(b) as being anticipated by Fuschetto.

Fuschetto does not teach, suggest, or disclose an integrated actuator meniscus mirror that includes an optical substrate including a mirror surface on one side and a support structure on the other that provides for strengthening and support of the mirror. Fuschetto also does not teach, suggest or disclose a plurality of actuators embedded in the support structure spaced from and generally parallel to the mirror surface for applying a bending moment to the mirror surface for controllably altering the shape of the mirror surface. Instead, Fuschetto teaches and discloses utilizing actuators connected between flexure

blocks attached to mounting pads on the mirror and a floating block at the center of the mirror:

> Shown is a mirror 11 having at its edges appropriate mounting pads 12 formed in the rear surface of the mirror. Three actuators in the form of piezo stacks, i.e., stacks of piezo electric ceramic discs, are provided and designated respectively 13, 15, and 17. The piezo stack 13 is arranged along what is called the $\phi 1$ axis, the piezo stack 15 along what is designated the $\phi 2$ axis and the piezo stack 17 along the y axis. Each piezo stack is split in two and thus piezo stack 13 is made up of sub-stacks 13a and 13b, stack 15, of sub-stacks 15a and 15b, and stack 17 of sub-stacks 17a and 17b. Each of the sub-stacks is connected between a floating block 19 at the center of the mirror and a flexure block 23 which is secured to one of the mounting pads 12. Connection of the piezo stacks to the floating block 19 is by means of a flexure 21.

Col. 2 lines 31-46, emphasis added.

The flexure blocks, mounting pads and a floating block at the center of the mirror as disclosed by Fuschetto are not designed for strengthening and supporting the mirror surface. Instead, the blocks, mounting pads and a floating block are used to dispose the actuators therebetween. The actuators as taught and disclosed by Fuschetto are clearly not embedded in the support structure.

Accordingly, Fuschetto does not teach, suggest, or disclose each and every element of the applicant's invention as recited in claim 1, namely, an optical substrate having a mirror surface on one side and a support structure on the other side, and a plurality of actuators embedded in the support structure spaced from and generally parallel to the mirror surface for applying bending moments to the mirror surface for controllably altering the shape of mirror surface.

Accordingly, claim 1 is allowable and patentable under 35 USC §102(b). Because claims 2, 5-9, 11 and 12 depend from an allowable base claim, these claims are allowable and patentable under 35 USC §102(b).

The Examiner rejects claim 4 under 35 USC §103(a) as being unpatentable over Sawicki, Döngi *et al.* or Fuschetto in view of Shuskus *et al.* The Examiner also rejects claim 10 under 35 USC §103(a) as being unpatentable over Döngi *et al.* or Fuschetto in view of Alden *et al.* As discussed above, neither Sawicki, Döngi *et al.*, nor Fuschetto, alone or in combination, teach, disclose or suggest each and every element of the applicant's invention as recited in independent claim 1. Alden *et al.* also fails to teach, suggest or disclose an optical substrate having a mirror surface on one side and a support structure on the other side, and a plurality of actuators embedded in the support structure spaced from and generally parallel to the mirror surface for applying bending moments to the mirror surface for controllably altering the shape of mirror surface. Accordingly, the Examiner's rejection of dependent claims 4 and 10 under 35 USC §103 is traversed.

Each of the Examiner's rejections have been addressed or traversed. Accordingly, it is respectfully submitted that the application is in condition for allowance. Early and favorable action is respectfully requested.

If for any reason this Response is found to be incomplete, or if at any time it appears that a telephone conference with counsel would help advance prosecution, please telephone the undersigned or his associates collect in Waltham, Massachusetts, at (781) 890-5678.

Respectfully submitted,

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